Proceedings of the 10th World Congress on Mechanical, Chemical, and Material Engineering (MCM'24)
Barcelona, Spain - August 22-24, 2024
Paper No. ICMIE 158
DOI: 10.11159/icmie24.158

Implementation of the 5S Methodology to Improve Efficiency in a Pastry Microenterprise San Ramon - Chanchamayo

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Summary- In Peru, the majority of pastry shops belong to micro and small companies, one of the problems they face is the deficiency of the production line due to the lack of order, cleanliness and good habits of the collaborators, so the objective of this article is to present the implementation of the lean manufacturing tool, which is the 5S method, which was implemented in the production area of a pastry company for a period of 4 months, the results are as follows: search time for pastry utensils and instruments reduced by 75%, 8 square meters recovered, marking 62% and organization of supplies 42%. A notable change was experienced: the meticulous organization of tools and materials, along with the standardization of processes, improved the distribution of cream filling, reducing defective products by 75% and increasing monthly revenue by 15%, reduction of 30 % in costs due to waste of materials and reduction in cleaning time to 15 minutes per day.

Key words: 5S Methodology, Efficiency, Microenterprise, pastry, production.

1. Introduction

According to the National Institute of Statistics and Informatics (INEI), 96% of the companies in Peru belong to Micro and Small Enterprises (MSEs), and among them are the pastry shops that present different challenges such as deficiency, unproductive time, poorly located inputs and untimely disposal, uncommitted staff, poor condition of the tools and lack of organization, which are a constant concern for this industry. From this arises the present investigation to implement the 5S methodology. The 5S is a technique to eliminate waste [1] is the continuous improvement that is implemented in many companies recognized worldwide, having as its main characteristics five activities. One of its objectives is to have an organized, orderly and clean work environment, in addition to recognize more easily the problems it is going through to subsequently improve quality and increase productivity. These concerns can be addressed using Lean tools such as 5S, which was applied in a Swedish farm and resulted in a reduction of defects and increased productivity by improving working methods and putting in place the necessary tools for each activity. [2] The 5S was first developed by Hiroyuki Hirano in Japan, it represents five principles to keep the workplace intuitive, this management tool establishes a good working environment in the company to ensure compliance with standards and foster a spirit of continuous improvement. [3] To apply it, we must act on deficiencies. Non-productive time will be defined as the control process developed based on modern tools used to reduce downtime. [4] Poorly located inputs increase delay, disorganization and tardiness in the process, interrupting input times for input purchase, validation and location for timely utilization. [5] Uncommitted personnel, it is known that the human value plays a very important role for the implementation of this technique because depending on the commitment of the workers the improvement will be reflected. [6] Each S corresponds to a set of advantages, among the most outstanding we can mention the improvement of establishments, process optimization, equipment availability [7] and accident reduction. The practice of 5S is good for any organization because it helps everyone to live a better life. In fact, many successful organizations around the world have incorporated some aspects of 5S into their daily operations without fully realizing the benefits [8] and have obtained incredible unexpected results. Such as the case of an organization that could not keep up with the demands of its buyers and its work was deficient. After implementing 5S, it not only reorganized but also helped to restore the scope of work and improve process flow.

After using 5S in the inspection department of a company, the time was saved by 39.60 % and also the process waste was reduced. [9] But the most important thing for full effectiveness is communication which is rarely evaluated, with these help employees develop their characteristics to decrease downtime, lead time, inventory, defects and associated costs. The organizational function cannot be separated from the human component. Because human construction has the potential to examine, discover, investigate and modify. [10] This implementation of 5S is very successful and common in industry, but it is unfortunate that it is still limited in the food industry. However, case studies demonstrate that the field of quality improvement in food-related industries is scalable. [11] The purpose of this study is to design a model to improve quality and efficiency in order to reduce latency, cross-contamination, etc. In the context of building other items, this study calls for rethinking high-level 5S tools to improve the focus of internal processes developed by employees that enable process optimization.[12] As a success story, one company implemented with 5S and Kaizen, which resulted in reduced production time, reduced risk and increased efficiency in manufacturing processes and warehouse management, sorting, plant allocation, work surface labeling, signage, redesign of various plant production surfaces. [6] implementation of this approach requires the commitment of everyone from operators to management. The organization's management must go beyond approving plans, expecting results, and communicating their interests and concerns to all other competitors. [13] This is why intense competition at the national level forces SMEs to make improvements, either directly or indirectly, by adopting different tools and processes to increase productivity and reduce production costs. Another case we have of a bakery in Guayaquil that for many years had had economic and personal problems in their processes, even lack of commitment of employees, [14] because they did not produce the expected product for not being involved in the trade. For the development of this article, we focused on waste and the problems it generates in the production area of a bakery in the city of Huancayo, Peru. The methodology used is based on a review and improvement approach based on the 5S.

2. Methodology

First, the company was visited to make a diagnosis in the production area, according to what was observed the problem is the low efficiency, having the following reasons: reason 1: unproductive times, (due to the delay in finding the inputs and utensils since these are not ordered and organized), Reason 2: Bad food handling practices (there is no good storage of equipment, utensils and supplies and the lack of practice of a cleaning and disinfection program) according to the requirements given by the Sanitary Standard For The Manufacture Elaboration And Sale Of Bakery, Biscuit And Pastry Products of RM 1020-2010/MINSA. Then the solution alternatives were analyzed and the implementation of the 5S Lean Manufacturing methodology was determined as a solution tool.

According to the above, we proceeded with the action plan for the implementation of the 5S methodology, for this we coordinated with the administrator of the company, we began with the formation of 5S teams, two teams were formed, each team of five members and defined who would be the sub-leaders, then a wall newspaper was installed in a strategic place to place the payroll of the 5S teams, audits to be conducted on each visit and some company notices,

Next, the first S was performed which is the Seiri (classify) this activity consists of separating the necessary and unnecessary items, the classification began at the first level where the cakes are made and ended at the second level, where they make the filling and decoration. To determine which objects are necessary and unnecessary, we coordinated with the administrator and the sub-leaders of those areas, and proposed to discard unnecessary objects those things that have not been used for more than 6 months, once identified these objects were moved to a discard area that was located outside the area, and the time that these objects will remain until they can be sold, donated or discarded.

Thus, more free space can be revealed in the production area, since all unnecessary objects were eliminated.

The second S is Seiton (sorting), this activity consists of defining a specific place for each object and having it put in its place after it has been used. The organization was carried out in conjunction with the administrator and the sub-leaders of each area. The filling supplies and filling tools were classified and organized according to the type of product, as was the case in the decoration area, in accordance with the Sanitary Regulations for the Manufacture, Preparation and Sale of Bakery, Biscuit and Pastry Products of RM 1020-2010/MINSA.

Seiso (clean) is the third S, based on identifying and eliminating sources of contamination, ensuring that all media are always in perfect condition. In this process of implementing the third S, dirty areas were identified, such as behind the refrigerators, shelves and ovens, and mixers, showing that the cleaning that was done at the end of each workday was superficial. With this, a cleaning was programmed behind these machines, ceilings and walls, another thing that was implemented was to place a container so that the dirt that was generated on the work tables would not fall to the floor. All of this was done together with the human work team based on sanitary regulations, thus avoiding cross-contamination.

The next step is to standardize, SEIKETSU; being the solution so that everyone can benefit from these improvements and multiply their impact. In this implementation, everything that was proposed in the previous 3's will be maintained, together with the administration, the daily supervision method will be maintained by going through the areas at the end of each workday, informing the workers of the new guidelines on order and cleanliness that must be followed at the end of each shift, as well as the sanctions that the workers will have when they do not comply with the above, and those who comply will be motivated with incentives.

Like SEIKETSU the fourth S, instead of implementing new activities, SHITSUKE maintains the old ones. By incorporating them into our daily work, we can say that they have become part of our way of working and have become a habit. In this implementation process, we are motivated to get into the habit of putting everything in its place, to follow the cleaning programs, removing the unnecessary to avoid the accumulation of waste. To achieve this objective, posters were pasted inside all areas so that workers become aware and gradually follow the rhythm of maintaining the areas on their own, to strengthen this commitment to generate this habit, competitions were implemented through a checklist in each area, whoever got the highest score would be awarded to the team involved, in order to achieve a habit both professionally and personally.

3. Results and Discussion

Each of the items that made up the approach yielded positive results. In the first S, all unnecessary objects in the workspace were eliminated. The activities carried out are detailed here:

- The 5 electronic scales that were not operational were removed and sold individually at a price of $15.00 each.
- Approximately 30 kilograms of expired supplies were eliminated, generating additional space for the storage of other supplies.
- Regarding to the 20 cake pans and tools that were no longer in use due to a change in the work methodology were removed and offered for sale at a price of $4.00 each.
- The removal of 6 kilos of electrical and TV cables that were in disarray did not serve any function was arranged. These cables were sold in their entirety for %40.00.
- Finally, the cartons, wooden boards and plywood that were on the top of the ovens were valued at $10.00 and sold.

As a result of the second S, focused on order, the activities carried out have generated concrete changes in the organization of space and have led to improved efficiency:

- Defined Transit Zones: The delimitation of transit zones has optimized the circulation of people in the plant, specially by clearly separating them from the work table areas.
- Structured Organization of Inputs: The orderly arrangement of inputs in designated shelves and containers, together with the strategic placement of utensils and tools according to specific functions (kneading, baking, filling, decorating and packaging), has improved operational efficiency.
- Labeling for Clear Identification: The labeling of containers with lids and shelves has provided clear identification of inputs, ensuring quick and accurate location, while simultaneously complying with established sanitary standards.

In the third S, the focus was on cleanliness, achieving the following results:

- Utensils and Tools in Impeccable Condition: As a result of the dedication to cleanliness, utensils, tools exhibited a constant state of cleanliness and disinfection, providing an impeccable and safe working environment.
- Efficient Execution of the Schedule: Effective implementation of the schedule by workers generated regular and planned cleaning, thus contributing to a hygienic and systematically organized work environment.

- Fully Sanitized Environment: The meticulous cleaning and disinfection of work tables, utensils and tools, using the appropriate materials and procedures, resulted in a work environment that was not only clean, but also in compliance with safety and hygiene standards.

As a result of the fourth s, the implementation of the audit schedule has generated significant impacts:

- Establishment of Clear Parameters: A clear set of parameters was established through the audit schedule, which specified the format to be used, evaluation criteria, review dates and dissemination methods.
- Active Staff Participation: The designation of the members of each team as auditors motivated active participation and a constant effort to maintain well-assessed areas. This direct involvement strengthened commitment to 5S practices.
- Continuous Improvement Though Feedback: The availability of detailed procedure manual for each team facilitated the understanding and effective application of 5S practices. Audit feedback thus became a valuable tool for driving continuous improvement in all areas assessed.

As a result of the implementation of the fifth phase, which consisted of the strategic placement of reminder posters, specific results were observed:

- Continuous Awareness: Strategically placed posters have maintained a constant awareness among workers of the crucial importance of order and cleanliness in their work environment.
- Clear Visual Reference: The posters have served as a clear and accessible visual reference, providing workers with a direct visual guide to the established standards for order and cleanliness.
- Increased Compliance: The presence of these visual reminders in key locations has proven to be effective in improving compliance with standards, fostering a cleaner and more organized work environment in accordance with 5S principles.

As a result of all actions implemented, the following significant results were achieved:

- A 19% reduction in the processing time of vanilla and chocolate cake was observed, thus improving process efficiency.
- There was a notable 75% reduction in the time spent searching for materials, optimizing the management and flow of resources.
- An average of 8 square meters of area was recovered, providing a more spacious and efficient environment for daily operations.
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Prior to the implementation of 5S, the pastry production area faced several significant challenges. Irregular distribution of cream filling in cakes was a frequent problem, caused by disorganization in the production area. Scattered ingredients and tools hindered the workflow, leading to errors and delays, resulting in 20% defective products and numerous customer complaints. In addition, cleaning was slow, with an average of 30 minutes to clean equipment and work areas, due to the accumulation of unnecessary utensils and materials due to the lack of cleaning practices and standardization. After the implementation of 5S, the workshop experienced a remarkable change: the meticulous organization of tools and materials, together with the standardization of processes, improved the distribution of cream filling, reducing defective products by 75% and increasing monthly revenues by 15%. In addition, the practice of sorting and classifying allowed a 30% reduction in material waste costs and reduced cleaning time to 15 minutes, which meant significant savings in operating expenses and an increase in productivity in the production area.

Table 1: Times per operation

Operación	(real time in minutes)		
	Before applying 5S	After applying 5S	Variation (%)

Cake making/processing	108	88	19%
Search for tools	4	1	75%

Evidence of before and after implementation:

Fig.1 shows the plant radar that was carried out before the implementation of the 5S methodology and Fig. 2 shows the plant radar that was carried out after the implementation of the 5S methodology.

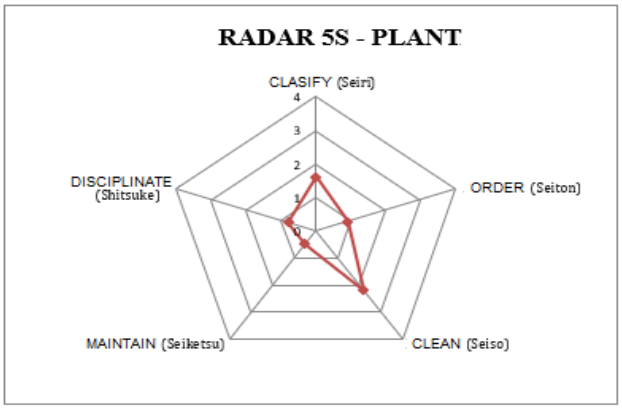

Fig. 1: Evidence of 34%. Plant radar before the implementation of the 5S methodology.

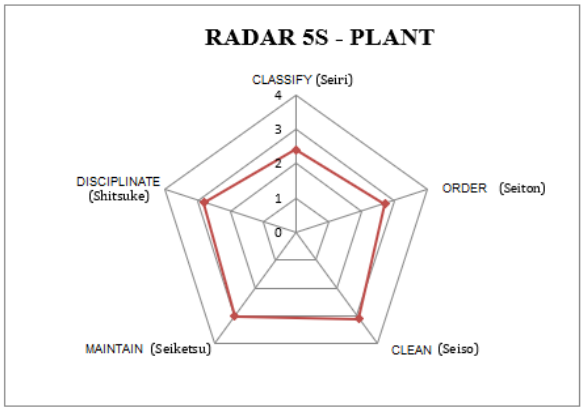

Fig.2: Evidence of 75%. Plant radar conducted after the implementation of the 5S methodology.

Fig.3 shows the packaging workstation before the implementation of the 5S methodology and Fig.4 shows the packaging workstation after the 5S implementation.

Fig. 3 Evidence of the packaging workstation before the implementation of the 5S methodology.

Fig. 4 Evidence of the packaging Workstation after the implementation of the 5S methodology.

Fig.5 shows the storage of inputs before the implementation of the 5S methodology and Fig.6 shows the storage of inputs after the implementation of the 5S methodology.

Fig. 5 Evidence of the storage of inputs prior to the implementation of the 5S methodology.

Fig. 6 Evidence of the storage of inputs after the implementation of the 5S methodology.

Fig. 7 shows the filling and decorating workstations before the implementation of the 5S methodology and Fig. 8 shows the filling and decorating workstations after the 5S implementation.

Fig. 7: Evidence of the filling and decorating workstation before the implementation of the 5S methodology.

Fig. 8: Evidence of the filling and decorating workstation after the implementation of the 5S methodology.

4. Conclusion

- The problem presented by the production area of the MSE is that there is a low efficiency, due to unproductive times, inputs, tools, and equipment poorly located, the improvement was made through the implementation of the 5S methodology based on the evaluation results after the implementation of the 5S methodology in the company for four months the results obtained are: Reduction of search times for materials and equipment by 75% average recovered area of 8 square meters and better organization of inputs, utensils and equipment, therefore, the implementation of the 5S methodology generates a positive impact on the company, both in terms of comfort of workers and in terms of economy, thus increasing company profits.
- Companies must allocate resources to implement 5S and comply with environmental management System standards. To ensure that 5S continues to work well, all employees receive advance information on the environmental management system to regulate 5S and comply with regulations.
- Work efficiency and effectiveness should not overlook the quality of the product produced within the bakery, a good work culture within a company is also very necessary for the future development of the company, so a good work culture, which took a lot of effort to achieve. The implementation of the 5S methodology is a joint effort to create a good work culture in the bakeries.
- At the end of the study, it could be observed that the bakery has a high level of service quality, low input waste and good work organization; therefore, it is confirmed that the application of the methodology used reinforces the improvement in service and product quality, ensuring results in a very significant way.
- Furthermore, by improving working conditions through practices such as order, cleanliness and standardization, we are promoting a safer, healthier and more pleasant working environment for the employees of these companies. This not only has a direct impact on their physical and mental well-being, but also contributes to fostering a positive and motivating work culture.
- The application of 5S is crucial to creating a work culture of continuous improvement and meeting quality and productivity standards in the food industry.
- The implementation of the 5S methodology in the bakery not only improved the quality of the cakes by reducing defects such as irregularity in the distribution of the cream filling in the cakes, but also optimized operating costs and improved efficiency in the cleanliness and organization of the work area. These improvements resulted in higher productivity and customer satisfaction, demonstrating the positive impact of 5S in a microenterprise.

References

[1] J. Velásquez-Costa, "Impact of the 5S methodology in the optimization of resources in metal mechanical companies," in Proceedings of the LACCEI international Multi-conference for Engineering, Education and Technology, 2022, vol. 2022-July. doi: 10.18687/LACCEI2022.1.1.594

[2] J. Bobadilla-Calderón, C. Martinez-Flores, and C. León-Chavarri, "Implementation of Integrated Autonomous Maintenance and Standard Work to improve the productivity in post-harvest production: Case study of a Peruvian coffee farm," in Proceedings of the LACCEI international Multi-conference for Engineering, Education and Technology, 2022, vol. 2022-July. doi: 10.18687/LACCEI2022.1.1.732.

[3] V. S. Kudryashov, M. v. Alekseev, A. v. Ivanov, I. A. Kozenko, and S. v. Ryazantsev, "Management of technological processes of transportation and drying of grain," in IOP Conference Series: Earth and Environmental Science, Feb. 2021, vol. 640, no. 6. doi: 10.1088/1755-1315/640/6/062015.

[4] M. A. V. Chiquito, J. C. G. Plua, and C. A. B. Pulley, "Modeling the Food Input Acquisition Process to Improve Traceability in Litopenaeus Vannamei Shrimp Production Using Blockchain," in Proceedings of the LACCEI

international Multi-conference for Engineering, Education and Technology, 2022, vol. 2022-July. doi: 10.18687/LACCEI2022.1.1.419.
[5] B S. Roy, K. Kumar, and B. Satpathy, "Strategic planning of optimising productivity: a '5S under lean quality' approach," 2021.
[6] S. E. M. Silvestre, V. D. P. Chaicha, J. C. A. Merino, and S. Nallusamy, "Implementation of a Lean Manufacturing and SLP-based system for a footwear company," Production, vol. 32, 2022, doi: 10.1590/0103-6513.20210072.
[7] P. Burawat, "Productivity Improvement of Carton Manufacturing Industry by Implementation of Lean Six Sigma, ECRS, Work Study, and 5S: A Case Study of ABC Co., Ltd," 2019. [Online]. Available: http://www.jett.dormaj.com
[8] C. Ruiz, T. Castillo, and M. Paredes, "Effects of implementation of 5S in heavy equipment maintenance workshops," in IGLC 28 - 28th Annual Conference of the International Group for Lean Construction 2020, 2020, pp. 577–588. doi: 10.24928/2020/0010.
[9] J. Singh, V. Rastogi, and R. Sharma, "Implementation of 5S practices: A review," Uncertain Supply Chain Management, vol. 2, no. 3. Growing Science, pp. 155–162, 2014. doi: 10.5267/j.uscm.2014.5.002.
[10] S. Karthik and & J. Silksonjohn, "A CASE STUDY OF 5S IMPLEMENTATION IN INSPECTION PROCESS," 2019. [Online]. Available: www.tjprc.org
[11] T. N. Projoth, R. R. Renish, K. Arun Kumar, and P. Jeyaraman, "Application of lean concepts in process industry," International Journal of Innovative Technology and Exploring Engineering, vol. 8, no. 10, pp. 1383–1386, Aug. 2019, doi: 10.35940/ijitee.J8812.0881019.
[12] J. Palomino-Cárdenas, R. Camacho-Obregón, and I. Macassi-Jauregui, "Increasing the service level in an industrial supplier company using the Winters Forecasting Method, Lean Warehouse and BPM," in Proceedings of the LACCEI international Multi-conference for Engineering, Education and Technology, 2022, vol. 2022-July. doi: 10.18687/LACCEI2022.1.1.729.
[13] C. Martínez and K. Barcia, "Propuesta para la Implementación de la Metodología de Mejora 5s en una Línea de Producción de Panes de Molde." "BINGQ-ISCE-20P20".
[14] S. Arcila, J. Zosa, J. Colina, J. García, And J. Quiroz, "Implementación del programa de 5s en la Panadería Chanis," Universidad Señor De Sipán, Pimental, Perú, 2020.